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HCI-BASED ERP AUDITING SYSTEM USABILITY ASSESSMENT FRAMEWORK

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Abstract

Internal control systems and auditing obligations have changed and transformed dramatically due to recent trends. Computer-assisted audit techniques and ERP computer auditing systems are being designed to address growing demands in auditing. These assist auditors in performing their auditing work where information technology is in place. However, they possess some technical limitations that are beyond the abilities and demands of auditors. To address these concerns, this study explores 28 usability features of ERP systems. The study is based on the human-computer interaction, and uses content analysis and the Delphi method for theoretical validation. Moreover, the study utilizes an experimental approach to develop and examine the usability assessment framework of the designated ERP computer auditing system. This study therefore contributes to the development of a sufficient and manageable assessment framework for ERP computer-assisted auditing systems, and it intends to provide researchers and businesses with prospective directions in this subject area.

Keywords: ERP Auditing Systems, Computer-Assisted Audit Techniques, Human-Computer Interaction, Usability Testing, Content Analysis, Delphi Method

1 INTRODUCTION

The rapid growth and development of IT systems have motivated companies to introduce enterprise resource planning (ERP) systems, and maintain real-time and integrated computing environments and e-commerce systems to assist in their daily operations. The introduction of ERP systems is essential for companies to stay competitive (Worthen 2003).

Maurizio et al. (2007) suggested that in implementing ERP systems, companies must establish corresponding and appropriate internal control systems to completely harness the benefits that ERP systems can bring. Many companies have introduced ERP systems—and that the transaction environment is massive and complex—auditors are tasked to examine carefully the effective mitigation of the risks and expected losses of audit failures. Consequently, auditors have been using computer-assisted audit techniques (CAATs) to help them resolve audit problems in the ERP environment. These techniques help auditors in effectively collecting and assessing relevant information so they can produce reasonable and accurate audit reports (Debreceny 2005; Li et al. 2007).

Despite its benefits, the software used to audit ERP systems faces a number of challenges and limitations (Lanza 2005; Li et al. 2007). The applicability of generic audit software is reduced due to varying system records and file allocation formats, different programming languages, and various brands of computer facilities. Lanza (2005) therefore suggested that different approaches be used under different audit environments. However, this could result in the difficulty of maintaining operational consistency. Moreover, auditors have to write programs for generic audit software, which are rather technical and beyond the scope of audit work. Additionally, the semantic gap between IT personnel and auditors, including the absence of warnings for abnormal transactions, leads to the lack of continuity in system monitoring (Li et al. 2007).

Software tools have limitations in terms of system features and efficiency for users. Therefore, the development of ERP audit systems should also consider the demands, capabilities, and limitations of target users (Santos 2006). Clearly, a modern computer audit system should be based on the human-centered development cycle, and understanding that the user interface grows significantly over time is necessary (Nielson 1993; Norman 1999; Preece 1998; Shneiderman 1998; Venkatesh et al. 2008). The human-computer interaction (HCI) examines interactions between humans and technologies by considering human demands and the usability of technology (Bostrom and Heinen 1977; Gerlach and Kuo 1991; Hefley et al. 1995; Nah et al. 2005; Seffah 2008; Zhang and Li 2005). In addition, HCI should consider the nature of tasks, as well as organizational and cultural factors (Zhang et al. 2002). If HCI methodology is considered, the design of any system will have higher usability (Carroll 1996; Mao et al. 2005; Vredenburg et al. 2002). Certainly, the ERP audit software is increasingly becoming important, but the problems associated with ERP systems should be considered. Meanwhile, majority of studies on ERP systems have focused on the motivation behind the introduction of ERP systems, key success factors, introduction methods, and analysis of benefits. On the other hand, few studies have delved on the influence of ERP systems on accounting procedures or audits (Chang et al. 2005; Huang et al. 2006). Accordingly, this research examines the characteristics required by ERP audit systems. Based on HCI, this research further tackles issues related to the conditions or characteristics required to make ERP computerized audit systems highly efficient. The objectives of this research are as follows:

- Examine the required usability attributes of HCI-Based ERP audit systems;
- Construct a feasibility evaluation mechanism for HCI-Based ERP audit systems; and
- Provide an empirical study on the feasibility evaluation mechanism of HCI-Based ERP audit systems.

2 LITERATURE REVIEW

To obtain an in-depth understanding of the study's scope, this section examines relevant discussions on , current status and challenges of ERP audit, and HCI and system usability.

2.1 Current status and challenges of ERP audit

The introduction of ERP systems has changed how corporations operate and has prompted companies to examine their internal control mechanisms. Effective changes are necessary to reduce corporate error and fraud (Bedard and Graham 2002; Glover et al. 1999). If corporate IT system reports contain flaws and fraud, data reliability and information security may be adversely affected, resulting in the lack of efficiency or

missed organizational targets (Ma et al. 2006).

Along with changes in the economic environment and transformations after the enactment of SOX 404, the functions of audits have evolved over time. From its passive role of preventing fraud, audit now performs an active role in facilitating benefits. Auditors are also tasked to improve their professional knowledge and experience in IT to effectively gather and assess relevant information, as well as issue-accurate and reasonable audit reports. Meanwhile, the appropriate use of CAATs does not only reduce audit risks—but also hastens audit jobs and reduces costs (Li et al. 2007).

Recently, there have been studies on techniques for auditors to review ERP systems (e.g., continuous audit system, system control, and generic audit software) (Brazel 2005; Li et al. 2007; Shaik 2005). However, existing tools used in auditing ERP systems, such as generic audit software, are confronted with many challenges and limitations. One limitation is the incompatibility of generic audit software with highly complex ERP database systems (Li et al. 2007). In addition, auditors often find difficulty in accessing audit data during their first use of generic audit software (Braun and Davis 2003). In using generic audit software, auditors must understand ERP data structure and system semantics, such as relevant database hierarchy and corporate flows. To set audit rules securely, auditors are also compelled to write programs (Frederick and Aleksandra 2000). Undeniably, these issues concerning the use of generic audit software present technical barriers. Therefore, the development of an ERP audit system, which considers the technical limitations of auditors, will greatly reduce audit costs and enhance user effectiveness and efficiency.

2.2 Human-computer interaction (HCI) and system usability

In the early years of IT management, there had been extensive discussions on human-machine interactions. . Gerlach and Kuo (1991) indicated that the behavior of users is an essential factor in system development. Moreover, in the life cycle of system development, the combination of user factors, usability attributes, and human-computer interactions reduces failures (Hefley et al. 1995; Zhang et al. 2005).

With respect to the abovementioned concerns, this research aims to assist in the development of an ERP computerized audit system by providing a list of considerations concerning the technical limitations of auditors in achieving their tasks. This paper is anchored on HCI to examine usability attributes required for various dimensions in the development of audit systems. HCI is a cross-disciplinary theory, which has been applied in the fields of industrial engineering, IT management, computer science, information science, psychology, sociology, and anthropology (Nah et al. 2005). The major issue is the interaction between humans and computers and its relation to usability. The characteristics of users' tasks have to be incorporated in the design, operations, and assessment of the interactive system to facilitate the development of a user interface that is both aesthetic and practical. HCI is concerned with allowing users to complete particular tasks with computer systems through the design of an appropriate interface. Zhang and Li (2005) summarized a range of discussions on HCI issues and described the most important subject of HCI studies over the years. They believed that the examination of the interaction between humans and computers alone cannot cover the complete HCI. Instead, a further understanding of the tasks assigned to humans, such as the targets of assignments, complexity of tasks, and other characteristics of task executions, is necessary. The "context" of tasks must also be addressed. An example is the environment within a country, society, organization, or group in which the tasks are executed. Examining the tasks and contexts creates a deeper understanding of the interaction between humans and computers. Further, the information acquired through the process also contributes to the solution of the problem. Thus, the incorporation of task/job structure and context to the interaction between humans and technology will result in a complete description of HCI research domains.

Usability, an important element in the progress of system development, is the target of HCI. Systems of lower usability often experience complaints and dissatisfaction from users, who eventually give up the systems (Anandhan et al. 2006). Usability attributes are conditions that enhance system efficiency and functionality. Some examples of usability attributes are good design elements, consistent design styles, comprehensive guiding structure, provision of timely and accurate messages regarding system status, shortening of response time, reliability of system operations, consideration of privacy and information security, and provision of complete services to users (Becker and Mottay 2001; Ferre and Juristo 2001). In addition, a system's usability can be accessed through usability tests. The test and enhancement of product usability, including an analysis of the application environment, can help identify the targets of usability and the methods to achieve such targets. Through tests, the usability of products is also assessed. Meanwhile,

usability tests establish the actual demands of users. They also confirm whether a system is within the scope of user capabilities, thereby identifying system errors that can potentially affect users. Hence, system developers use information derived from these usability tests as references for improvements (Koubek et al. 2003; Nielsen 1992 and 1993). Similar to system development, system usability tests should include questions concerning designs and thoughts. They should establish testing flows and should be complete by combining all relevant factors that affect user executions of the system, such as ease of learning, efficiency, ease of memorization, error rates, and satisfaction (Anandhan et al. 2006). The frequently used assessment methods for system usability are laboratories, field studies, expert reviews, surveys, and CARE (cheap, accurate, reliable, and efficient) testing (Anandhan et al. 2006; Shneiderman 1998).

3 METHODOLOGY

3.1 Research method and design

This paper utilizes the Gowin's Vee structure (Gowin 1981) in the formulation of research strategies. In this study, the usability attributes of the ERP audit system are first summarized through content analysis. The Delphi method is also used to confirm the usability attributes and to construct a usability assessment mechanism for ERP audit systems. Finally, this paper aims for an audit system for Oracle ERP procurement and current payment cycle systems through the CARE approach to implement the assessment mechanism that this paper constructs. CARE is adopted and the sequence of analysis is as follows (Anandhan et al. 2006): (1)Definition of problems and targets; (2)Preparation of task lists; (3)Scheduling and implementation of assessment;(4)Data collection; and Analysis of results.

Content analysis is used to generalize the usability attributes of ERP audit systems. Content analysis is an objective method that systematically describes communication contents (Krippendorff 1980). Compared with more common qualitative research methods, content analysis can be validated and systematically quantified. Moreover, its data sources are unlimited (Carley 1997; Duriau 2007; Tesch 1990). In terms of implementation procedures, this paper first examines a body of literature relevant to usability; hence, open coding is performed on contents relevant to usability attributes. Open coding is the initial coding or conceptualization of recently gathered data. It also involves information decomposition, reviews, comparison, and naming through constant comparisons and questioning. Finally, the five dimensions proposed by Zhang and Li (2005) for the HCI model (i.e., human, technology, interactions, tasks/jobs, and context) are utilized. These dimensions are considered as classification dimensions of the main coding—to analyze and generalize the usability attributes summarized through open coding.

The usability attributes derived from both axial and selective coding in the design of the Delphi expert questionnaire. The questionnaire survey is conducted to confirm the practicality and suitability of the usability attributes. The Delphi method is used to focus on a certain research topic by inviting a group of pre-selected experts, such as a Delphi panel, to express their opinions. These opinions are then gathered, summarized, and organized to establish a consensus (Okoli and Pawlowski 2004). With the opinions obtained from auditors who, at the same time, have practical experience, this paper confirms not only the usability attributes relevant to ERP audit systems, but also the levels of importance and ways of measurement of individual attributes.

Results from the aforementioned stages are gathered. Thereafter, a prototype assessment mechanism for the ERP audit system is established. This prototype is then used in the system assessment as the empirical basis of the usability test. At this stage, the CARE testing method is applied because the method can specifically define the steps of usability assessment, including question definitions, target setting, and preparation of task lists, scheduling and implementation of assessment tasks, data collection, and analysis of findings. Compared with other usability tests, such as users' tests and the Q&A model, CARE involves less time and finances. However, in terms of reliability, it is superior to questionnaire surveys (Anandhan et al. 2006).

4 CONSTRUCTION OF HCI-BASED ERP AUDIT SYSTEM USABILITY ASSESSMENT

4.1 Coding of usability attributes

This paper establishes a usability assessment mechanism for software systems and examines usability issues from the perspective of an interactive interface. The following keywords are used to search through the literature: "usability," "human-computer interaction," "interface," and "software."Using 25 published materials, the usability attributes are subjected to open coding and numbering.

For example, Abran et al. (2003) stated that system usability consists of three usability attributes:

- ⌘ How well do users achieve their goals using the system?
- ⌘ What resources are utilized to achieve their goals?
- ⌘ How do users feel about their use of the system?

Accordingly, "usability is a major decision point in selecting a product, as this decision will have a direct influence on the learn ability of the chosen system... learn ability is defined as a simple attribute, 'time of learning'... as a set of software attributes which relates to its ability to prevent unauthorized access, whether accidental or deliberate, to programs and data."

With regard to the above discussion, the following results are conceptualized:

1. Level of task and target completion users achieve by using the system
2. Resources spent to complete tasks
3. Users' feelings about the system
4. Time spent on learning the system
5. Ability to avoid illegal access to programs or data, purposefully or not

This paper uses the five dimensions of the HCI model proposed by Zhang and Li (2005). Finally, selective coding is used to derive 28 usability attributes by grouping conceptualized results that refer to the same phenomenon.

Although various names are mentioned herein, all statements are nevertheless related to the phenomena and the completion status of tasks. Therefore, descriptions of the six usability attributes are categorized into one and named "effectiveness of task implementation." Table 1 summarizes the results of the selective coding.

Dimension	Item	Scope (Usability Attributes)	Literature
Human	1	Users' subjective opinions and feelings about the system	Abran et al. (2003), Federal Election Commission (2003), Han et al. (2000), ISO 2001, Nielsen (1993), Qiu et al. (2006), Ravden et al. (1989), , Shackel (1991), Shneiderman (1998),
	2	Resources required to learn how to use the system	Abran et al. (2003), Han et al. (2000), Qiu et al. (2006), Shackel (1991), Shneiderman (1998)
	3	Types and number of system errors caused by users' behavior	Shneiderman (1998)
	4	User memorization of system-related knowledge	Dringus and Cohen (2005), Han et al. (2000), Nielsen (1993), Qiu et al. (2006), Shneiderman (1998),
	5	Training curriculum in system operations	Preece et al.(1995)
	6	Ability of users to understand system operations and structure	Ravden et al. (1989)
	7	Enhance positive experience of consumption and usage by provision of accessible customer services	Becker and Mottay (2001)
Technology	8	Mechanism that prevents system errors	Dringus and Cohen (2005), Ravden et al. (1989), Pang et al. (2005),
	9	System information feedback mechanism	Becker and Mottay (2001), Dringus and Cohen (2005), Nielsen (1992), Preece et al. (1995), Ravden et al. (1989), Federal Election Commission (2003), Pang et al. (2005),
	10	Flexibility for modifications on operational interface	Dringus and Cohen (2005), Ravden et al. (1989), Pang et al. (2005),
	11	Instruction mechanism for system operations	Becker and Mottay (2001), Dringus and Cohen (2005), Nielsen (1992), Preece et al. (1995), Ravden et al. (1989), Federal Election Commission (2003), Pang et al. (2005),
	12	Assistance provided to users for easy memorization of attributes to alleviate their memory burden	Nielsen (1992),

	13	Consistency of system designs	Becker and Mottay (2001), Dringus and Cohen (2005), Nielsen (1992), Ravden et al. (1989), Federal Election Commission (2003), Pang et al. (2005),
	14	Compliance of system design with generally accepted accounting rules	ISO 2001, Nielsen (1992), Pang et al. (2005),
	15	Aesthetic design of operational interface	Becker and Mottay (2001), Dringus and Cohen (2005), Han et al. (2000), Pang et al. (2005)
	16	Effectiveness of the operating system	Becker and Mottay (2001),
	17	System offers functions relevant to task executions	Dringus and Cohen (2005), Ravden et al. (1989)
	18	Users' control mechanism over the system	Dringus and Cohen (2005), Han et al. (2000), ISO 2001, Qiu, et al. (2006), Ravden et al. (1989), Pang et al. (2005),
	19	Reliability and stability of the system	Becker and Mottay (2001), Nielsen (1993),
	20	Readability of data contents	Dringus and Cohen (2005), Nielsen (1992), Ravden et al. (1989), Federal Election Commission (2003), Pang et al. (2005),
	21	Ease of system installation and set-up	Federal Election Commission (2003)
	22	Construction of easy-to-use interfaces with an understanding of users' cognition patterns and habits	ISO 2001, Nielsen (1993), Nielsen (1992), Preece et al. (1995), Federal Election Commission (2003), Pang et al. (2005),
	23	The types and numbers of users the system is able to support	Dringus and Cohen (2005), Nielsen (1992),
Interaction	24	Effectiveness of task executions	Abran et al. (2003), Shackel (1991)
	25	Efficiency of task executions	Abran et al. (2003), Dringus and Cohen (2005), Nielsen (1993), Preece et al. (1995), Shneiderman (1998), Federal Election Commission (2003), Hussey et al. (2001)
Tasks/Jobs	26	The types and numbers of tasks the system is able to support	Shackel (1991)
	27	Enabling users to understand clearly whether the system meets the task requirements	ISO 2001
Context	28	System security and privacy	Abran et al. (2003), Becker and Mottay (2001)

Table 1. System Usability Attributes

4.2 Results of the Delphi expert questionnaire survey

This paper utilizes the Delphi expert questionnaire survey to examine usability attributes suitable to the evaluation of ERP audit systems. A total of 30 experts, whose average work tenure is 3.4 years, are included in the Delphi panel. Among them, 28 (93%) are currently working in, Price Waterhouse Coopers, Deloitte Touche, Ernst & Young, and KPMG

Furthermore, the questionnaire is designed using the five-point Likert scale. The questions are divided into two dimensions: levels of suitability and degrees of importance, both involving the expression of expert opinions. "Levels of suitability" is used to determine whether specific usability attributes are appropriate or not for the evaluation of ERP audit systems. The attributes are rated as "very suitable," "suitable," "ordinary," "not suitable," and "very unsuitable" on a descending scale from 5 to 1, respectively. If the final tally shows that a certain attribute is highly suitable, that attribute is incorporated into the feasibility assessment mechanism for the system. On the other hand, "degrees of importance" is used to determine the weights of attributes. The attributes are rated as "very important," "important," "ordinary," "unimportant," and "very unimportant" on a descending scale from 5 to 1, respectively. In addition, a space is provided where experts may write and express their supplementary opinions.

To verify whether the average score of the "levels of suitability" is significantly higher than 3, independent sample t-test is used. The test helps in deciding whether it is proper to keep the attribute in question. Meanwhile, a quartile deviation of "levels of suitability" among the experts that is greater than 0.6 indicates high inconsistency in terms of consensus among the experts with respect to the attribute concerned (Holden and Wedman 1993). In such case, the attribute is eliminated.

The significance of individual usability attributes is determined based on the average score of the degrees of importance. Results from the first round of questionnaire survey show that all the reserved usability attributes meet the criteria, except for three: users' ability to understand system operations and structures, aesthetic design of the operational interface, and ability of the system to support the types and numbers of users (Table 2). The supplementary opinions of the experts, including the willingness of the audited units to be audited, compatibility of the IT system used by auditors, and the computerized audit system and audit trails required for all access records, are also incorporated into the questionnaire. Thereafter, the second round of questionnaire survey is conducted. The results of the second round have met all the criteria for

reservation, and all the figures have indicated high consistency. With such results, a third round is not needed. The summary of results from the second round of expert questionnaire survey is presented in Table 3.

Tables 2 and 3 present the weights of individual usability attributes. In terms of "human" dimension, the experts believe that "system client services" is the most important element, followed by "overall perceptions about the system," "time spent on learning how to use the system," "errors throughout the task implementation process," "information shown on memory interface," and "the willingness of the audited units to be audited." On the other hand, the experts have paid minimal attention to "education and training curriculum arranged for the system." Furthermore in terms of "technology" dimension, the experts believe that "fault-tolerance mechanism," "response time," and "operating efficiency" are the most important elements. On the contrary, the experts are less concerned with "system design consistency," "levels of difficulties in reading through system information," and "installation and set-up time." With respect to the "interaction" dimension, "work effectiveness" and "work efficiency" are both important, although the former is considered slightly more important. In the "task" dimension, "work types applicable to the system" and "whether users understand the application domains" are equally important according to experts. Finally, in the "context" dimension, "security and privacy mechanism" and "design of audit trails" are considered by experts to be extremely and equally important. After the two rounds of Delphi expert questionnaire surveys, the usability attributes of the ERP audit system, along with their corresponding weights, have been confirmed. Hence, the prototype mechanism for ERP audit system usability evaluation is established.

			Independent t-stat test of suitability					
Dimension	No	Usability Attribute	Average	t*	P-Value	Deletion	Quartile Deviation	Weighting
Human	1	Users' subjective opinions and feelings about the system	3.92	6.06	0.000		0.00	4.00
	2	Resources required to learn how to use the system	3.96	7.10	0.000		0.00	4.00
	3	Number of system errors caused by users' behavior	3.84	4.45	0.000		0.50	4.00
	4	User memorization of system-related knowledge	4.00	6.55	0.000		0.00	4.00
	5	Training curriculum in system operations	3.56	2.91	0.000		0.50	3.00
	6	Ability of users to understand system operations and structure	3.12	0.68	0.250	X	1.00	3.90
	7	Enhance positive experience of consumption and usage by provision of accessible customer services	4.04	7.70	0.000		0.00	4.00
Technology	8	Mechanism that prevents system errors	4.44	10.11	0.000		0.50	5.00
	9	System information feedback mechanism	4.08	6.26	0.000		0.50	4.00
	10	Flexibility for modifications on operational interface	3.56	3.22	0.002		0.50	4.00
	11	Presence of instruction mechanism for system operations	3.96	7.86	0.000		0.00	4.00
	12	Ability of the system to reduce memory burden of users	4.16	7.25	0.000		0.50	4.00
	13	Consistency of system designs	3.24	1.81	0.040		0.50	3.00
	14	Compliance of the system design with GAAP	3.56	3.65	0.000		0.50	4.00
	15	Aesthetic design of the operational interface	3.24	1.45	0.080	X	0.50	4.50
	16	Effective and efficient operation of the system	4.20	8.49	0.000		0.50	3.90
	17	Functions offered by the system are relevant to task executions	3.96	7.10	0.000		0.00	4.00
	18	The system is equipped with effective control mechanism	4.00	7.07	0.000		0.00	5.00
	19	Reliability and stability of the system	4.36	7.49	0.000		0.50	3.00
	20	Readability of data contents	3.72	4.55	0.000		0.50	3.00
	21	Ease of installation and setting up of the system	3.32	2.14	0.020		0.50	4.00
	22	Simplicity and ease of use of the interface	3.60	3.67	0.000		0.50	4.00
	23	Types and numbers of users the system is able to support	3.20	1.16	0.130	X	0.50	3.90
Interaction	24	Effectiveness of task executions	4.28	8.09	0.000		0.50	4.50
	25	Efficiency of task executions	3.96	7.10	0.000		0.00	4.20
Tasks/Jobs	26	The types and numbers of tasks the system is able to support	4.00	7.07	0.000		0.00	4.00
	27	Enabling users to understand clearly whether the system meets the task requirements	4.04	11.44	0.000		0.00	4.00
Context	28	System security and privacy	4.4	10.84	0.000		0.50	5.00

Table 2. Independent t-stat and Consistency Test of Suitability of the First Round Delphi Questionnaire

Dimension	Item	Usability Attribute	Independent t-stat test of suitability				
			Average	t*	P-Value	Quartile Deviation	Weighting
Human	1	Willingness of the audited units to be audited	3.52	2.33	0.020	0.50	4.50
Technology	2	Compatibility of the IT system used by auditors and the IT system used by the audited units	4.05	6.49	0.000	0.50	5.00
Context	3	Audit trials required for all access records	4.43	8.08	0.000	0.50	5.00

Table 3. Independent t-stat and Consistency Test of Suitability of the Second Round Delphi Questionnaire

5 EXPERIMENTAL ANALYSIS AND DISCUSSION

This study experiments on the applicability of the prototype mechanism for HCI-Based ERP audit system usability evaluation to assess the feasibility of a currently used ERP audit system. To assess usability, CARE is adopted and the sequence of analysis. As far as the ERP audit system is concerned, this paper assesses the usability of a computerized audit system designed for Oracle ERP. The system is constructed to comply with all the requirements stipulated in SOX 404, specifically in terms of the effectiveness of internal control. It is dedicated to the procurement and payment cycles of Oracle ERP. Further, it consists of 34 key audits or control points that are SOX 404 compliant in terms of procurement and payment cycles. The system may also be operated using Microsoft Windows XP, enabling the exportation of audit results to Excel. Meanwhile, the audit system can save the audit checklists as XML files and then read the XML files back into the audit checklists when running. The checklists can be stored within the system in XML format and printed out when necessary. Alternatively, it can be exported to HTML webpages to be shown on a web browser in accordance with the XSLT format defined by users (Chang et al. 2008).

In the definition of questions and checklist of audit tasks, this paper initially attempts to understand the usability of the Oracle ERP audit system, particularly if it is to be used by personnel who have never used it before. Meanwhile, this research refers to the work environment and the functionality of the system as key audit points required for the tasks to be assessed.

For this reason, testers from Graduate Institutes of Accounting and Information Technology are selected as respondents, given that they are the potential users of ERP audit systems. They also have to study the curriculum associated with computer-assisted auditing. Therefore, they have an evident understanding of the usability requirements of such systems. 37 participants have filled in the necessary information in the questionnaire, which is already the prototype mechanism for ERP audit system usability evaluation. In addition, the said questionnaire has been constructed after the Delphi experts confirmed the data during the previous stage (Table 4), and their inputs have been incorporated into the paper-based questionnaire.

Cronbach's alpha of the questionnaire used to assess the usability of the ERP system is 0.895, indicating that the answers obtained through this mechanism are highly reliable (Hair et al. 1998). Meanwhile, the concentration of the answers has also been analyzed. Results show that 50% of the responses are clustered around the same scale for three questions: "users' subjective opinions and feelings about the system," "readability of data contents," and "effectiveness of task execution." These figures show that respondents' opinions about the three usability attributes are highly consistent. In addition, 50% of the responses are clustered around two scales for 16 questions, and 50% of the responses fall within three scales for nine questions. Overall, the data points of the individual questions are within the three scales; this is an acceptable range.

Responses from users who have and have not studied advanced accounting are significantly different, indicating that the former exhibit greater variance in their views on the usability of ERP audit systems. For this reason, giving due consideration to the background of users becomes important. Among the individual questions regarding usability attributes, seven scales are provided to respondents to determine the scores they assign to these attributes. The weighted average scores of the respective attributes are derived from the original score multiplied by the weights. Finally, the sum of scores of the 28 attributes is the rating for the usability of the ERP audit system.

Results show that the attribute "effectiveness of the operating system" has the highest score, indicating that the system performs best. On the contrary, the attribute "flexibility for modifications on operational interface" has the lowest score, suggesting that the flexibility of the system for interface modifications still needs improvement. Based on the empirical implementation, the mechanism for ERP audit system usability evaluation exhibits high reliability and consistency. Furthermore, it is able to identify issues concerning the system's usability, thereby providing a reference for system modifications.

Dimension	Item	Usability Attribute	Measurement			Weight
Human	1	Users' subjective opinions and feelings about the system	Very unsatisfied	1 2 3 4 5 6 7	Very satisfied	4.00
	2	Resources required to learn how to use the system	Very long	1 2 3 4 5 6 7	Very short	4.00
	3	Number of system errors caused by users' behavior	Many	1 2 3 4 5 6 7	Few	4.00
	4	User memorization of system-related knowledge	Very difficult	1 2 3 4 5 6 7	Very easy	4.00
	5	Training curriculum in system operations	Completely ineffective	1 2 3 4 5 6 7	Very effective	3.00
	6	Willingness of the audited units to be audited	Very low	1 2 3 4 5 6 7	Very high	4.50
	7	Enhance positive experience of consumption and usage by provision of accessible customer services	Very unsatisfied	1 2 3 4 5 6 7	Very satisfied	4.00
Technology	8	Mechanism that prevents system errors	Completely ineffective	1 2 3 4 5 6 7	Very effective	5.00
	9	System information feedback mechanism	Very unhelpful	1 2 3 4 5 6 7	Very helpful	4.00
	10	Flexibility for modifications on operational interface	No flexibility	1 2 3 4 5 6 7	Complete flexibility	4.00
	11	Presence of instruction mechanism for system operations	Completely ineffective	1 2 3 4 5 6 7	Very effective	4.00
	12	Ability of the system to reduce memory burden of users	Completely ineffective	1 2 3 4 5 6 7	Very effective	4.00
	13	Consistency of system designs	Very inconsistent	1 2 3 4 5 6 7	Very consistent	3.00
	14	Compliance of the system design with GAAP	Very incompliant	1 2 3 4 5 6 7	Very compliant	4.00
	15	Compatibility of the IT system of the audited units and the IT system of auditors	Very short	1 2 3 4 5 6 7	Very high	4.50
	16	Effectiveness of the operating system	Very high	1 2 3 4 5 6 7	Very short	3.90
	17	Functions offered by the system are relevant to task executions	Very irrelevant	1 2 3 4 5 6 7	Very relevant	4.00
	18	The system is equipped with effective control mechanism	Completely ineffective	1 2 3 4 5 6 7	Very effective	5.00
	19	Reliability and stability of the system	Very unstable	1 2 3 4 5 6 7	Very stable	3.00
	20	Readability of data contents	Very difficult	1 2 3 4 5 6 7	Very easy	3.00
	21	Ease of installation and setting up of the system	Very difficult	1 2 3 4 5 6 7	Very easy	4.00
	22	Ease of use of the interface	Very difficult	1 2 3 4 5 6 7	Very easy	4.00
Interaction	23	Effectiveness of task executions	Very poor	1 2 3 4 5 6 7	Very good	4.50
	24	Efficiency of task executions	Very low	1 2 3 4 5 6 7	Very high	4.20
Tasks/Jobs	25	The types and numbers of tasks the system is able to support	Very limited	1 2 3 4 5 6 7	Very versatile	4.00
	26	Enabling users to understand clearly whether the system meets the task requirements	Very unclear	1 2 3 4 5 6 7	Very clear	4.00
Context	27	System security and privacy	Very unimportant	1 2 3 4 5 6 7	Very important	5.00
	28	Audit trials required for all access records	Completely ineffective	1 2 3 4 5 6 7	Very effective	5.00

Table 4. Prototype Mechanism for ERP Audit System Usability Evaluation

6 CONCLUSIONS

To enhance the efficiency and quality of audit work through the use of ERP audit systems, this study utilized the HCI to construct a usability assessment mechanism. This paper applied content analysis to gather 25

publications relevant to system usability and coding into five dimensions. Through two rounds of discussions by Delphi expert panels, this paper confirmed 28 usability attributes and their respective significance to HCI-based ERP audit systems, to construct the mechanism for HCI-based ERP audit system usability evaluation. Finally, this paper used the CARE method and the Oracle ERP system to perform the usability assessment and to obtain an empirical basis, respectively. The empirical analysis determined the reliability and the consistency of the mechanism for ERP audit system usability evaluation to access information.

One major contribution of the mechanism for HCI-Based ERP audit system usability evaluation is that its mechanism may assist practitioners and relevant organizations in assessing the usability of this type of system. With respect to auditing units, the mechanism enables an ex-ante evaluation of systems to ensure their high usability and ability to provide effective audit jobs. The mechanism also greatly contributes to developers of ERP audit systems. It helps them identify usability demands so they can develop supporting tools that will address the specific needs of auditors. For academics, this study tackles the issue of software usability for system development by examining the required usability attributes using assessment criteria. In this regard, a new direction is provided for academics to review CAATs research. Many CAATs have been introduced to address the dilemma of auditing work. However, it does not mean that these have effectively assisted auditors in completing their tasks or solving their problems. The possibility of the effective usability assessment of software systems (before the completion of development or after actual applications) can greatly enhance the acceptability, effectiveness, or efficiency of software.

This paper adopted the five dimensions proposed by Zhang and Li (2005) in the classification of axial coding. These five dimensions are human, technology, interaction, tasks/jobs, and context. However, the ratio in the number of usability attributes was not particularly ideal, especially the dimensions of interaction, tasks/jobs, and context in which each contained only two usability attributes. This may have affected the content validity of the evaluation mechanism. Therefore, follow-up studies that delve more into appropriate classifications are recommended. This will help obtain a consistent number of attributes for individual dimensions. Meanwhile, the determination of attribute weights was based on statistical methods. The researchers therefore recommend that future studies use other methods (e.g., the analysis hierarchy process) to determine the weights of respective attributes. Finally, due to the limitations of time and resources, this paper utilized a small sample for the CARE usability assessment stage. Follow-up studies can use the same approach and conduct tests with different respondents and different systems at different stages. In doing so, the reliability and validity of the empirical results can be enhanced.

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